

COMBINED SYNCHROTRON FTIR AND RAMAN MICROSCPECTROMETRY OF THE FLUID INCLUSIONS IN THE BENCUBBIN METEORITE

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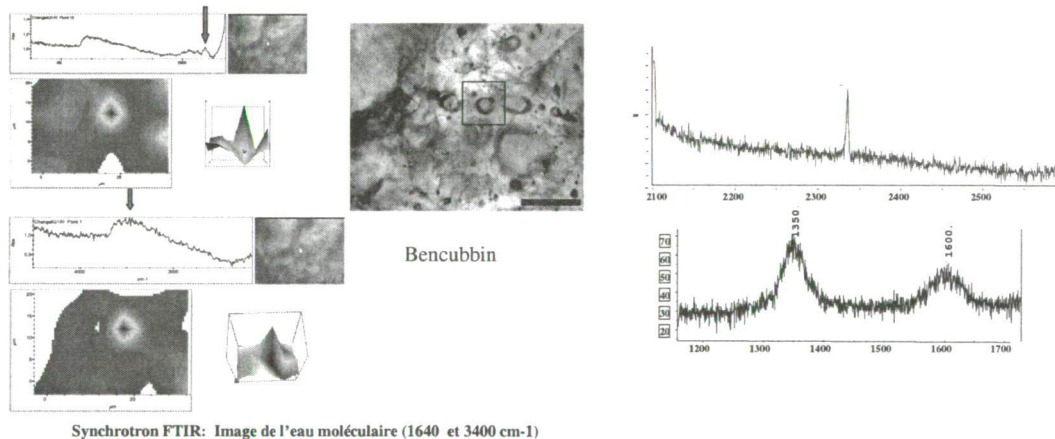
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The Bencubbin meteorite belongs to a group of six meteorites considered as very primitive. It is a breccia composed of centimetre to millimetre clasts of different types of components. Fe-Ni metal and silicate clasts are embedded in a matrix which is a shock-melted mixture of silicates and metal. Microscopic and SEM observations revealed the presence of abundant bubbles in various silicate components, with sizes in the range <1 to 40 μm (Figure 1). Nitrogen isotopic measurements of the gas obtained by crushing samples of these components have shown an important amount of nitrogen with a strong enrichment in ^{15}N (about a factor two, Marty et al., 2000) considered as an indication of a presolar origin. The inclusions and their matrix were punctually analysed by a combination of Raman and Synchrotron infrared microspectrometry (SFTIR). Raman analyses were performed on thin sections with a JY T64000 using a confocal system, in the single monochromator mode. The laser power (514.5 nm) used was restricted to 0.5mwatt to avoid destruction. SFTIR analyses and mapping were performed using a Nicolet Nic Plan confocal microscope with a Synchrotron source in mid infrared range and aperture of 2X2 μm . (Guilhaumou et al., 1998). We tried to localize and identify the fluids to understand their origin and their links to the shock episodes and associated thermal events.

In situ Raman microspectrometry reveals molecular nitrogen (N_2) as the main component with a band position systematically near 2330 cm^{-1} , indicating a partial pressure slightly higher than atmospheric pressure. By moving the focus slightly in the same inclusion, spectra are recorded with peaks around 1350 and 1580 cm^{-1} , characteristic of poorly graphitized carbon. Peak positions and ratio of these two peaks indicate an order of graphitisation in response to shear and heating (Bustin et al., 1995). This carbon phase is found as black solid particles in rare flat fluid inclusions. Water is not detected in our analytical conditions.



Synchrotron FTIR: Image de l'eau moléculaire (1640 et 3400 cm^{-1})

Figure 1: SFTIR mapping and Raman spectra of gaseous FI in glass

SFTIR molecular mapping surprisingly reveals molecular water in FI characterized by both its stretching vibration at 3200-3400 cm^{-1} and bending vibration at 1640 cm^{-1} . Water is detected in all nitrogen- and carbon-bearing fluid inclusions analysed. As this component is not detected by Raman spectrometry it is probably under the detection limits, indicating a very low water amount. Some few-micron sized silicate grains are also imaged associated to FI inclusions. The FI-bearing-glass is brown coloured and appears from FTIR profiles as partly devitrified (silicates) at a micron scale. These results raise the problem of conditions, timing and origin of these fluids. As the Bencubbin meteorite is a breccia, the present day bubble content necessarily results from the transformation of an initial component. The event responsible for that is most probably a high shock event that induced rapid heating and degradation of previous organic matter. But the preserved enrichment in ^{15}N which is very uncommon in meteorites and is an indication of a very primitive (presolar) atmosphere is surprising.

References

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MARTY et al. (2000): Lunar Planet. Sci. **XXXI**, (abstract).
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